

Bradley A. MacLeod

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PhD Research Scientist
Device Physicist
Electrical Engineer

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located in Denver, CO

EDUCATION

University of Washington, Seattle, WA

Ph.D. Chemistry and Nanotechnology
Specializing in Materials and Physical Chemistry
Graduated March 2012
Advisor: David S. Ginger

University of Alaska Fairbanks, Fairbanks, AK

B.S. Electrical Engineering
Specializing in Communication Engineering
Graduated in May 2005 with Cum Laude and Leadership Honors

WORK EXPERIENCE

National Renewable Energy Laboratory (NREL), Golden, CO

Postdoctoral Researcher
March 2012 to March 2015

- Demonstrated improved device performance and stability in organic solar cells through surface modification of electrical contacts
- Led team of researchers to demonstrate proof-of-concept toward development of efficient solar water splitting devices
- Simulated absorption properties in tandem quantum dot solar cells, provided visualization of large datasets, provided guidance to optimize engineering of devices
- Published results in high-impact journals and presented work (oral and written) at major professional conferences
- Maintained *Qualified Electrical Worker* status in support of the research team

University of Washington (UW), Seattle, WA

Graduate Student and Research Assistant

July 2006 to March 2012

- Awarded National Science Foundation Graduate Research Fellowship grant, funding my graduate research for three years (2007 to 2010)
- Developed complex experimental apparatus to perform electroabsorption and charge modulation spectroscopies, including specifications, software programming in LabVIEW, custom machining of parts, and optimization of controls systems for cryostat operation
- Developed deep understanding of the influence of electrical contacts on device operation in organic solar cells
- Published results in peer-reviewed journals, and presented posters at major professional conferences and funding agency meetings
- Conducted beamline experiments at the Stanford Synchrotron Radiation Lighthouse (SSRL), a part of the Stanford Linear Accelerator Laboratory (SLAC)
- Supported research team's information technologies capabilities with custom hardware and software configuration (VPN, NAS, bridging, etc.)
- Supported multi-department research facility in maintenance and upgrades of glovebox systems, thermal evaporators, vacuum systems, and spincoater equipment

NANA/Colt Engineering, LLC, Anchorage, AK

Engineering Intern

January 2006 to July 2006

- Assisted the Professional Engineer in code-compliance review of CAD drawings and design for electrical power distribution systems in oil field well pads

International Business Machines (IBM), Rochester, MN

Failure Analysis Engineer Co-op

May 2004 to August 2004

- Inspected failed motherboard components at IBM's server manufacturing facility
- Routine analyses included visual inspection, microscopy, solder repair, and firmware diagnostic software.

Siemens Building Technologies, Inc., Fairbanks, AK

Engineering Specialist

May 2003 to April 2004

- Designed and installed heating, ventilation, and air conditioning (HVAC) systems, as well as other business services (smart card readers)
- Administered a project to renovate the HVAC system of an entire floor of the Geophysics building at the University of Alaska Fairbanks

- The renovation project included design and specifications of electronic controllers and other hardware, installation of HVAC products, tuning PID control of the HVAC system, and programming of the graphical user interface for the customer's HVAC operator.

State of Alaska, Department of Transportation & Public Facilities, Anchorage, AK

Intern

July 2002 to January 2003

- Assisted the *Professional Engineer* by researching worldwide highway interchange roundabouts projects for the design of Alaska's first interchange roundabout construction project.

VECO Alaska, Inc., Prudhoe Bay, AK

Electrical Safety Inspections Intern

Summer 2001

- Inspected safety documentation for code-compliance
- Piloted a snowcat on the tundra of the Prudhoe Bay Oil Field for cleanup crew

PRESENTATIONS

Talks:

- "Stability of Inverted Organic Solar Cells with Sol-Gel-Deposited ZnO Electron Contact Layers"
Materials Research Society Fall 2014 Meeting, Symposia U/P, December 2014
- "Enhanced stability of ZnO-based inverted organic photovoltaic devices by phosphonic acid modification"
American Physical Society March 2014 Meeting, Session D25, Denver, CO
- "Electroabsorption spectroscopy: Finding your built-in potential"
Center for Interface Science: Solar Electric Materials, a U.S. DOE EFRC, Tucson, AZ, October 2010
- "Measuring electric fields in organic photovoltaics"
The Center on Materials and Devices for Information Technology Research, a National Science Foundation Science and Technology Center, University of Washington, October 2009

Posters:

- "Stability of inverted organic solar cells with ZnO contact layers deposited from sol-gel precursors"
Excitonic Photovoltaics 2014, Telluride, CO, August 2014

- "Improved Performance in Bulk Heterojunction Organic Solar Cells with Sol-Gel MgZnO Electron-Collecting Layer"
Materials Research Society Fall 2013 Meeting, Symposium Y, December 2013
- "Improved Performance from Solution-processed Small Molecule Solar Cells by Hole-collection Optimization"
Materials Research Society Spring 2013 Meeting, Symposium B, April 2013
- "Probing nanometer-scale energetics and orientation of molecules at interfaces"
U.S. Department of Energy: Energy Frontiers Research Center Summit, Washington D.C., May 2011
- "Electroabsorption spectroscopy for screening electrode functionalization in organic solar cells"
Materials Research Society Fall 2009 Meeting, Symposium D, December 2009
- "Electrode functionalization in organic solar cells"
National Science Foundation: The Center on Materials and Devices for Information Technology Research, University of Arizona, February 2009
- "Space charge limited photocurrents and mobility measurement in bulk heterojunction solar cells"
Gordon Research Conference: Electronic Processes in Organic Materials, July 2008

SELECTED HONORS AND AWARDS

- Carl Storm Underrepresented Minority Fellow, 2008
- National Science Foundation Graduate Research Fellow, 2007 (3 years stipend and tuition)
- Graduation with Leadership Honors, 2005
- American Indian Science and Engineering Society Chapter of the Year, 2004
- A.T. Anderson Memorial Scholarship, 2004
- University of Alaska Scholars Award, 1999 (4 years tuition)

TEACHING, COMMUNITY, OUTREACH

- Mentored master's student Jonas Boé general laboratory skills and organic photovoltaic device fabrication and characterization, NREL, 2014
- *Pacific Science Center Science Communication Fellow*: developed and administered interactive demonstration for nontraditional science education, Seattle, WA, 2011 to 2012
- *Co-Director, web administrator, blogger, and book club organizer* of The Forum on Science Ethics and Policy (FOSEP, seattle.fosep.org), Seattle, WA, 2010 to 2012

- Demonstrated biodiesel synthesis for local Seattle high school students, 2010
- Developed online educational material for plastic electronics, including video demonstration (bit.ly/sVxxXP), 2010
- Presented poster and demonstrations at Shoreline SolarFest, Shoreline, WA, 2009
- Presented poster “How do plastic solar cells work?” to the Seattle community leaders at Seattle Chamber Leadership Conference, 2009
- Mentored honors undergraduate chemistry student Noah E. Horwitz, University of Washington, 2008 to 2011
- Teaching Assistant for general chemistry, University of Washington, 2006 to 2007
- Led the chapter of American Indian Science and Engineering Society (AISES) as *Co-President*, University of Alaska Fairbanks, 2004 to 2005
- Led recitations and study sessions for the Alaska Native Science and Engineering Program (ANSEP), University of Alaska Anchorage, 2003

SKILLS

- atomic force microscopy (AFM, EFM/SKPFM)
 - Asylum MF3PD and Park XE-70 systems
 - diagnostic use: organic and inorganic semiconductors, film thickness, topography, conductive contact mode, scanning Kelvin probe surface potential mapping, current-voltage measurements with/without confocal laser illumination
 - repairs: high voltage piezo power circuits
- computer-aided design
 - AutoCAD: design review
 - Solidworks: device testing chamber design
 - Sketchup: furniture design
- computer programming
 - DD-WRT, OpenVPN, and Tomato Firmware: open source VPN configuration of off-the-shelf routers for laboratory and personal networking and for network attached storage data backup.
 - GitHub collaborative code management
 - Igor Pro: modeling of optical field intensity in complex semiconductor devices (tandem photovoltaics) for optimization of layer thicknesses and current generation, programming for the control of the Asylum MFP3D atomic force microscope to perform custom experiments, routine use for data analysis and plotting for most experimental data

- LabVIEW: coded complex controls for electroabsorption, charge modulation, quantum efficiency, cryostat, and pixels-switching relay for solar simulator and diode current measurements
 - Maple: for graduate Quantum Chemistry course simulations
 - Mathematica: general undergraduate coursework
 - MATLAB: for undergraduate simulations of the oxygen transport in human respiration and graduate optical modeling of electric fields in organic photovoltaics by transfer matrix method
- cryostats and temperature control
 - for electrooptical experiments as well as thermal evaporator systems
 - repairs: epoxy sealing of windows, vacuum leak checking, electrical wiring for device interfacing and switching
- electrochemistry:
 - photocurrent onset, Mott-Schottky analysis, and electrodeposition for photoelectrochemical cells
- Kelvin probe
- machining & fabrications
 - semiconductor device fixtures for use in vacuum and cryostat chambers
 - furniture
 - materials: acrylic, aluminum, copper, Delrin, plastics, Teflon (PTFE), wood
 - tools: CNC, drill press, lathe, milling machine, saws
- solar simulator
 - photovoltaics current-voltage and photoelectrochemical analyses
 - design of device-testing chambers and fixtures
- solution-processing
 - spincoating of organic semiconductor and metal-oxide thin films
 - bladecoating organic semiconductor thin films
- spectroscopies
 - charge modulation spectroscopy (CMS):
built experiment with EAS plus new programming, data collection, data analysis
 - electroabsorption spectroscopy (EAS):
built experiment as main focus of graduate work – programming, machining, calibrations, light sources, cryostat, vacuum chambers, automation, sample preparations, data collection, data analysis
 - ellipsometry:
sample preparation, data analysis
 - external quantum efficiency (EQE):
built experiment with EAS, sample preparations, data collection, data analysis
 - Fourier Transform Infrared (FTIR): ATR, DRIFTS, transmittance, Thermo Nicolet 6700

- inductively coupled plasma – atomic emission (ICP, ICP-AE):
sample preparation, data collection, minimal data analysis
- inverse photoemission spectroscopy (IPES):
sample preparation, data analysis
- near-edge X-ray absorption fine structure (NEXAFS) at Stanford Synchrotron Radiation
Lightsource (SSRL):
sample preparation, sample mounting (resistive welding) and loading, data collection
- photoinduced absorption spectroscopy (PIA):
sample preparation, data collection, data analysis
- ultraviolet photoelectron spectroscopy (UPS):
sample preparation, data collection, data analysis, Phi & Kratos systems
- UV-Vis absorption/reflection spectroscopy:
routine sample preparations, data collection, minimal analysis required
- X-ray photoelectron spectroscopy (XPS):
sample preparation, data collection, data analysis, Phi & Kratos systems

- thermal evaporator
 - organics semiconductors, metals, metal oxides
 - repairs: vacuum reconditioning, cleaning/descaling of vacuum chamber, diagnostics,
replacement of high voltage power transformers, design of system upgrades: shielding
and source insulation to prevent shorting due to metallic depositions

- thin film device fabrication
 - solution processing and thermal evaporator
 - film characterizations (AFM, spectroscopies, Kelvin Probe)
 - device characterization (solar simulator, electroabsorption spectroscopy, quantum
efficiency)

- vacuum sciences
 - UHV experiments (see spectroscopies):
sample preparations, vacuum operations, leak detection and repair, data collection, data
analysis
 - Stanford Synchrotron Radiation Lightsource (SSRL)
 - pump maintenance/overhaul